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## ROYAL GARDENS, KEW.

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### BULLETIN

OF

### MISCELLANEOUS INFORMATION.

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No. 40.]

APRIL.

[1890.

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#### CXXXVIII.—CANAIGRE.

(*Rumex hymenosepalum*, Torr.)

In 1885 the Government of India applied to Kew for information about a new tanning material of which practically nothing was known in the Old World. And the name had become so corrupted that it was by a mere accident that a clue was found to its identification. Under the name of Canaigre root, an account of it was indeed to be met with in the valuable Reports of the Department of Agriculture of the United States Government for 1878 and 1879. A nearly complete set of these is contained in the library of the Royal Gardens. But they are perhaps the last place where information on such a subject might be expected to be found. And even here this interesting product would seem to have had a narrow escape of being buried in oblivion. The specimens reported on, which were also the first which seem anywhere to have received attention, were received by the Department from Northern Texas in 1868, but lost sight of for ten years. The conclusion

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of the Report left it doubtful whether the future of the product was to be found in pharmacy or the arts:--

"Whether this root is valuable either for tanning purposes or for medicinal use must be determined by actual experimentation. The result of the analysis fails to show the presence of any substances that would prove injurious to leather, and the large proportion of tannic acid is certainly a favourable indication. In many particulars this root resembles rhubarb, and it seems probable that it may be used to advantage in place of rhubarb, where a more astringent medicine is indicated."

#### GOVERNMENT OF INDIA TO ROYAL GARDENS, KEW.

SIR,

Simla, September 4, 1885.

I AM directed to enclose an extract from the *Leather Trades Circular* of the 8th August 1885, regarding the discovery of a new tanning agent in the plant known as "Gouagra," and to say that the Government of India will be glad to learn whether the seed of the plant is procurable.

I have, &c.

(Signed) E. BUCK,

Secretary to the Government of India.

W. T. Thiselton Dyer, Esq.

#### [ENCLOSURE.]

Extract from the *Leather Trades' Circular*, dated August 8, 1885, page 621.

#### NEW TANNING AGENTS.

. . . . An Arizona paper states that a new tanning agent, likely to be of great value, has been discovered, one which also has the property of adding weight to the leather. The plant is an annual, and grows upon desert and dry upland soil. It is known by the Mexicans and Indians as "Gouagra." The discoverer is Mr. Edwards. The Report states that the plant has a root somewhat longer and more scraggy than the cultivated beet, though resembling it in appearance. Practical use demonstrated that its tanning properties were about three times as great as the common oak bark, and that in all essentials it was superior to the bark in the manufacture of leather. . . . .

Extract from the "Chronique de la Société Nationale d'Acclimatation," October 5, 1885, page 147.

Le *Journal des Cultivateurs* signale, d'après les publications américaines, une nouvelle substance tannante de grande valeur, découverte il y a peu de temps. Cette plante réussit très bien dans les déserts et hauts plateaux secs. La partie tannante est la racine un peu plus longue que celle des betteraves; elle doit renfermer trois fois plus de tanin que l'écorce de chêne. Les Mexicains et les Indiens la nomment *Ganagra*. Ce signalement suffit pour reconnaître en cette substance les caractères du *Rumex hymenosepalum*, ou racine de Canaigre.



## ROYAL GARDENS, KEW, to GOVERNMENT OF INDIA.

SIR,

Royal Gardens, Kew, October 9, 1885.

I HAVE to acknowledge the receipt of your letter 729/126-2 A., inquiring if the seed of a new tanning agent, known as Gouagra, is procurable.

2. The French "Chronique de la Société Nationale d'Acclimatation" for October 5, 1885, p. 147, contains a notice of this plant, from which it appears that the reputed tanning agent is the root of *Rumex hymenosepalum*.

3. This plant is a native of Western North America, where it is known as Canaigre, of which the name cited by you is probably a corruption.

4. The stems and leaves are acid like rhubarb, and, according to Watson and Gray's Botany of California, are used in California and Utah accordingly under the name of Wild Pie plant. In Texas the roots are used for tanning purposes.

5. Her Majesty's Consul at Galveston might possibly be able to procure seeds.

6. The Canaigre is doubtless only suited to a dry and warm temperate country. It can hardly be doubted that India itself possesses many tanning materials better worth attention.

I am, &amp;c.

(Signed) W. T. THISELTON DYER.

E. Buck, Esq.,

Secretary to the Government of India,  
Calcutta.

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Here the matter rested till recently. It was brought again into notice by the following article, which appeared in the Pharmaceutical Journal and Transactions for September 7, 1889, pp. 187, 188. In the face of the present high price of tanning materials, of which the case of Gambier affords an example (see Kew Bulletin for October, 1889), it seems desirable to reprint this paper in continuation of the history of the subject:—

## CANAIGRE.\*

By HENRY TRIMBLE.

The following account of a tanning material, which has several times in the past few years been mentioned as new, or as a possibility for the tanner, is undertaken with a view of relating what has been done toward developing this source, and at the same time calling attention to the fact that if we encourage home production we have in Canaigre a material which gives promise of superseding the uncertain and much adulterated gambier.

Canaigre is found in large quantity in the sandy soil on both sides of the Rio Grande and northward over a large portion of Western Texas and New Mexico.

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\* Contribution from the Chemical Laboratory of the Philadelphia College of Pharmacy. No. 56. From the *American Journal of Pharmacy*, August, 1889.



Its history is briefly as follows:—It is said to have been used in tanning by the Mexicans for over two centuries. Our first information, however, dated from July 9, 1868, when a package of these roots was forwarded for Mr. John James, of San Antonio, Texas, to the Agricultural Department at Washington, together with a letter stating that Mr. F. Kalteyer, chemist in San Antonio, had found them to contain 32 per cent. of tannin. This sample was mislaid or overlooked until 1878, when it was reported on by the chemist.\* It was then found to yield 23·45 per cent. of tannin. A fresh sample was also procured, and the tannin estimated in the still fresh root with almost identical results, after making due allowance for difference in moisture. The other constituents reported at that time need not claim our attention at present further than to notice a considerable amount of starch, 18·00 per cent.

Previous to this publication by the Government, Mr. Rudolph Völcker, of Galveston, Texas, published† an analysis of roots gathered in July 1874. He found 23·16 per cent. tannin, and proved the presence of crysophanic acid and aporetin. He was not aware of the botanical origin of the plant, but supposed it to belong to the natural order Polygonaceæ.

In 1879, Mr. William Saunders‡ in his report on Canaigre stated it was the *Rumex hymenosepalum* of Torrey, and furnished a lithographic plate of the plant in bloom.

At the New Orleans Exposition, 1885–86, in one corner of the section devoted to products from New Mexico were some of these roots, above which was the inscription, “a new tanning material.”

As will be shown later, this exhibit, insignificant as it appeared, attracted the attention of at least one person.

In 1886,§ a sample of a root sent to me from San Antonio, Texas, under the name of “Indian Root,” was analysed and the results published under the title of “Yerba del Indio,” from the impression it was the *Aristolochia fatida* of the Mexican Pharmacopœia. This impression, however, was corrected by Professor J. M. Maisch in the same issue, page 115. He suggested, and it has since been found to be correct, that this “Raiz del Indio” was the Canaigre root. That analysis fixed the amount of tannin at 11·66 per cent., but it was found that the root, which was not analysed as soon as received, had commenced to decay and, later, it was completely riddled by insects. In this respect my experience differed from that of the Government chemist, who found no change after ten years.

Soon after the New Orleans Exposition samples of two or three hundred pounds were sent to Chicago for experiments in a number of tanneries there. Mr. E. C. Denig of that city has devoted much time since then to studying this material, from its source in Texas and New Mexico to its application in the tanning of hides.

Canaigre consists of heavy globular and fusiform pieces from two to six inches long and one to three inches in diameter. Externally it is of a dark, reddish-brown colour, becoming, by age, almost black; internally it is from a bright to a brownish-yellow according to age and amount of exposure to atmosphere. When collected the roots consist of clusters resembling sweet potatoes. They are found near the surface or some-

\* Report of the Commissioner of Agriculture, 1878, p. 119.

† An Analysis of Raiz del Indio, *American Journal of Pharmacy*, 1876, p. 49.

‡ Report of the Commissioner of Agriculture, 1879, p. 364.

§ An Analysis of *Aristolochia fatida*, *American Journal of Pharmacy*, 1886, p. 113.



times on top of the ground, are rapidly dried and, at a certain stage, cut into small pieces. If allowed to get very dry they become so hard as to resist any ordinary method of cutting. From samples of the whole and clipped root kindly furnished me by Mr. Denig, I have found 17.33 per cent. of tannin. This figure is rather lower than that obtained by other investigators, but the deficiency may be explained by my sample containing more moisture. Dr. H. E. Sturcke\* has found a total of 28.57 per cent. tannin.

The ground root is at present used in a number of tanneries, and has been found to more closely resemble gambier in its action than any other tannin material. An extract has also been prepared and used which contains from 40 to 60 per cent. tannin, and it is thought that in this form it will probably replace gambier. Should the hopes and efforts of those who are engaged in the development of this material be realised, we shall have a source of tannin which is said to be inexhaustible, and which will be the means of either bringing a better gambier into this market or of driving it entirely out of use here. It is said that the dried and ground root can be delivered in any part of the United States at a price not exceeding 3 cents per pound.

Thus after a delay of 20 years this root has reached that stage of practical application when a useful future may be predicted for it, and the persistent efforts of the past four years have every prospect of being rewarded.

The presence of so much starch in a tanning material is, perhaps, without precedent, and there are good reasons why this is no disadvantage. The properties of the pure tannin have not been investigated, and it is not known whether Canaigre red or gallic acid is the product of its decomposition. Crystals have been obtained by agitating an aqueous extract of the root with ether, which do not resemble either gallic acid or catechin.

This crystalline compound and the pure tannin are under investigation by me at the present time.

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Application was next made to the United States National Museum for the supply of specimens for examination and preservation in the museums of the Royal Gardens.

ROYAL GARDENS, KEW, to UNITED STATES NATIONAL MUSEUM.

SIR, Royal Gardens, Kew, September 11, 1889.

I HAVE the honour to inform you that my attention has been drawn to an article on Canaigre—a new tanning article, said to be the root of *Rumex hymenosepalum*—by Henry Trimble, in the *Pharmaceutical Journal* for September 7, 1889, p. 187, copied from the *American Journal of Pharmacy* for August 1889. I find that the museum of the Royal Gardens contains no sample of Canaigre, and I therefore venture to ask that you will kindly procure a specimen of the root for this establishment.

Dr. Brown Goode,  
United States National Museum,  
Washington, U.S.A.

I am, &c.  
(Signed) D. MORRIS.

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\* *Shoe and Leather Reporter*, Oct. 27, 1887, p. 882.



ASSISTANT SECRETARY, UNITED STATES NATIONAL MUSEUM, to  
ROYAL GARDENS, KEW.

United States National Museum, Washington,

DEAR SIR,

November 22, 1889.

YOUR letter of September 11 was duly received. Having no specimens of Canaigre in the collection, I wrote to Dr. F. H. Goodwin, of Tucson, Arizona, and from him we have just received a few specimens, which I now take pleasure in sending to you.

We are always glad to render you any assistance in our power.

Yours, &c.

W. T. Thiselton Dyer, Esq.,  
F.R.S.

(Signed) G. BROWN GOODE.

A portion of the material so kindly procured by Dr. Brown Goode was submitted to Mr. W. N. Evans, who has on many occasions kindly assisted the Royal Gardens with valuable information.

Mr. W. N. EVANS, F.C.S., to ROYAL GARDENS, KEW.

DEAR SIR,

66, Stackpole Road, Bristol, March 18, 1890.

YOUR favour of the 12th came duly to hand, with sample of Canaigre roots, and I am glad to be able to enclose analysis of the same, which shows that the roots will be a valuable addition to our list of tanning products. It is very curious to notice the different results of previous analyses, but it is useless attempting to test any product until it is sufficiently dry to grind or pulverise.

I presume, from its growing in Texas, that it will flourish in suitable soil in any temperate climate, and may be grown to any extent with but little attention. I trust it may be a great blessing to the trade, as just now our principal materials, such as valonia and gambier, are scarce and dear.

Of course it has yet to be tried in the tannery, but there appears to be nothing, so far as we can see, that should prevent its full value from being realised.

I remain, &c.

D. Morris, Esq.

(Signed) W. N. EVANS.

[ENCLOSURE.]

Tanners' Laboratory, 66, Stackpole Road,  
Bristol, March 17, 1893.

COPY of ANALYSIS of Canaigre root received from the Royal Gardens,  
Kew.

Tannin	-	-	-	-	37.48
Organic matter	-	-	-	-	11.20
Water	-	-	-	-	12.07
Ash	-	-	-	-	0.20
Woody fibre	-	-	-	-	39.05
					<hr/>
					100.00
					<hr/>



Remarks:—Original moisture very considerable, as much as 55·85 per cent. Had to be dried to grind. The above analysis taken in this condition yet shows 12·07 per cent. of water.

### CXXXIX.—PISTACHIO CULTIVATION IN CYPRUS.

The Pistachio nut is the fruit of a small tree, with 3 to 5 broad-ovate leaflets, native of Syria, Mesopotamia, and Persia, which is cultivated in Sicily and other parts of Southern Europe. It is dioecious, that is to say, the male and female flowers are borne on separate trees. The physiological distinction though, as will be seen, understood in Sicily is, perhaps, imperfectly appreciated in the East, and the trees which bear male flowers are regarded, probably, merely as barren. At any rate, the terms male and female, when applied to fertile trees, simply indicate slight varieties. As in the case with most fruit trees, it is found advantageous to graft the seedling trees. The advantages are twofold; they come earlier into bearing, and thus time is gained, and, secondly, what experience has shown to be the best varieties are perpetuated.

The following correspondence relates to an attempt which has been made to introduce the Pistachio nut into Cyprus. The information as to its cultivation at Aleppo appears to be more detailed than any which has been previously published.

MR. ALFRED K. BOVILL TO ROYAL GARDENS, KEW.

SIR,

Nikosia, Cyprus, August 15, 1889.

DURING the winter of 1887-88 I procured some Pistachio nuts, and made an official experiment with them. The experiments I continued during the winter of 1888-89, and last spring I sent in an Official Report on the subject, which I believe is to be printed in the Cyprus Blue Book for 1888-89.

Since then I have been reading as far as circumstances will allow, and have also communicated with the British Consul at Aleppo; a copy of my questions and his replies are enclosed for your information.

• • • • •

I am, &c.

D. Morris, Esq.

(Signed) ALFRED K. BOVILL.

#### THE CULTIVATION OF THE PISTACHIO VERA AT ALEPPO.

Q. 1. How is the Pistachio tree produced, from seeds or cuttings?

A. 1. Produced from seed only, the seed whole and not split is steeped in water for two days, then planted in July in the nurseries and watered at least twice a week for two years, when it is grafted (then about 3 feet high) from a good fruit producing tree. After another year it is transplanted to the Pistachio gardens, where it is again watered for a year, or until the roots are well fixed, and then left to nature, no more water being given.

The Pistachio gardens are ploughed up twice a year in spring and winter, and the spade is used round each tree as with the olive.

Q. 2. Does it naturally reproduce itself?

A. 2. It does not naturally reproduce itself, although cases happen, when the ground is exceptionally moist, of seeds fructifying after falling from the tree, but this is very rare.



Q. 3. Is it better to irrigate it ?

A. 3. Irrigation is not favourable to the Pistachio.

Q. 4. How many years after the seed is sown does it produce fruit ?

A. 4. The tree begins to produce fruit two years after being grafted.

Q. 5. Is the tree ever grafted ?

A. 5. The tree is invariably grafted.

Q. 6. Are the trees male and female ?

A. 6. The distinction between male and female is not understood at Aleppo. Those trees bearing much fruit of a good quality, viz., short but thick seeds, are supposed to be female, while those giving a poor crop of long thin seeds are popularly held to be male. Grafting is done, however, from the most fertile and best fruit-producing tree, *i.e.*, the female. Few so-called males thus exist.

Q. 7. What is the yield of fruit the first year they come into fruit ?

A. 7. The first year after beginning to bear the crop is very small, only after seven years of age does the tree give a good crop.

Q. 8. What is the comparative yield of fruit each year afterwards ?

A. 8. The comparative yield of a tree largely depends upon circumstances unknown; trees all proceeding from the same seeds giving different results in size and crop. Twenty to 50 okes are perhaps an average. Some trees give as much as 30 rattles; very rare, and others again only four or five rattles; reasons unknown. The Pistachio, like the olive, has alternate years of good and bad crops. (1 oke=2·8 lbs.; 1 rattle=2 okes.)

Q. 9. How many years do they remain in bearing ?

A. 9. Ordinary good trees bear a long time, 60 to 80 years. Excessive frost sometimes dries them up, when they are cut down, and uprooted as shoots never appear.

Q. 10. To what size does the tree grow ?

A. 10. The tree attains the height of 12 to 15 feet.

Q. 11. In what kind of land does it thrive best ?

A. 11. It thrives best in a whiteish chalky clay soil which retains moisture; in this and many other respects it resembles the olive.

Q. 12. Will it thrive on rocky soil ?

A. 12. It thrives also on rocky, stony, soil, with about 25 to 30 inches of soil. The roots seeking moisture amongst the rocks.

Q. 13. Does it grow better by the sea or inland ?

A. 13. Attempts to grow by the sea have never been tried. It is only found inland, the climate of which is dry.

Q. 14. What is the rainfall at Aleppo ?

A. 14. The rainfall at Aleppo is unknown. It is probably between 11 and 15 inches, or, say, half the fall on the coast line, which is mountainous. As a rule the rainy months are January, February, and March; between May and end of October no rain falls.

*Note.*—If a nursery of young trees could be raised at Cyprus, grafts from Aleppo could be procured when the young trees attain a height of 3 feet and the thickness of a man's finger, say, after two year's planting. In the process of grafting honey is often used.

(Signed) THOS. S. JAGO.

Aleppo, June 25, 1889.



Parlatore ("Flora Italiana," vol. 5, p. 375) gives the following account of the method of artificial fertilisation, formerly practised in Sicily :—

"In Italy the principal seat of the cultivation of the Pistachio is to be found in the provinces of Catania and Girgenti; but those grown at Bronte in Sicily are especially esteemed for their excellence. In order to obtain a crop a process of artificial fertilisation has from ancient times been practised in Sicily. The fertilising dust (pollen) of the male plant, which flowers earlier than the female, is collected in a small bag and scattered over the female flowers as soon as they open; another method is to collect and dry the male flowers and apply them to the female. This procedure is adopted when the trees of the two sexes grow apart; otherwise the action of the wind suffices to effect natural fertilisation, since in this case there are always some male flowers whose period of opening correspond to that of the females. This method is almost exactly similar to that practiced in the East from the remotest times in the case of the date; but at the present time it has either fallen into disuse or at any rate is restricted to a few localities, and the Pistachio trees fertilise themselves without artificial aid.

"The Sicilians employ either the male or the female plant of the Chio or Cyprus turpentine tree (*Pistacia Terebinthus*) to serve as a stock on which to graft the Pistachio."

## CXL.—INDIAN SUGAR.

The enclosed correspondence is in great part a selection from a file of documents sent to Kew from the India Office, with the suggestion that the subject might be noticed in the *Kew Bulletin*. The production of sugar is a question which has its economic as well as its botanical side. Into the former Kew is in no way competent to enter. It can, however, hardly be doubted that if natural conditions alone operated sugar production would be confined to tropical countries. It is in point of fact so closely proportioned to available solar energy, that extra-tropical countries, on equal terms otherwise, would not have a chance. Under existing circumstances it is interesting to observe from the concluding letter of the correspondence that European sugar is now invading India, which can hardly be regarded as otherwise than a purely artificial result.

A discussion of the papers seemed to require some practical knowledge of Indian agricultural conditions. They were therefore placed in the hands of Mr. C. B. Clarke, F.R.S., late of the Bengal Educational Department, who is now occupied with scientific work at Kew. Few persons probably have a better acquaintance with Indian rural economy, and the remarks which he has been so good as to furnish in the following letter, will no doubt, therefore, be found to be a further and useful introduction to the subject.

C. B. CLARKE, Esq., F.R.S., to ROYAL GARDENS, KEW.

Herbarium, Kew,  
March 22, 1890.

MY DEAR THISELTON DYER,

In reply to your call on me I send you some remarks on the correspondence regarding sugar-cane cultivation in India, which con-



cludes with the India Office No. 238 of 27th February 1890, addressed to you.

The correspondence opens with a letter from Messrs. J. Travers, of London, referring mainly to the processes of manufacture (of which I know nothing), but the evidence collected in India proves that the high local price of the cane in India is the main reason that India cannot compete with Mauritius and the West Indies in exporting sugar. So that the problem is almost purely agricultural.

The important letter is that of Mr. Goodridge, who knows the subject in Nagpore, but who does not know the circumstances in the far more important province of Bengal. Mr. Goodridge says, for instance, that in the West Indies and Mauritius they have 40 to 57 inches of rain per annum well spread, and that in India the cane requires irrigation because the rainfall is so much less.

This is true of Nagpore (or parts of it); and the Government of India start by asserting that the first main difficulty which the sugar-cane industry in India has to contend against is the limited supply of water for irrigation.

Now in all Bengal proper (*i.e.*, excluding Behar) the rainfall is at least 70 inches a year, spread from 1st April to 31st October, and I never saw in that area sugar-cane irrigated in my life, except (rarely) a little water-pot work at starting. The "comparatively limited areas in East Bengal with a moist climate," mentioned in paragraph 7 of the Government of India's letter, include nearly all Bengal from Calcutta to Dinajpur and from Burdwan to Comilla, an area enough to raise all the sugar used in the world. The ordinary soil of Bengal, sand and clay in various proportion, suits sugar-cane very well, and it is often seen on the very margin of a bheel without injury from waterlogging.

The causes why the natives do not grow sugar more successfully, set out by Mr. Goodridge, are correctly stated, but there are others. In Bengal, sugar-cane is often in half acre plots; it does not pay the cultivator to watch so small a piece, therefore, every boy, every gharry wallah who passes, takes a few canes, and every elephant takes many. Gross robbery is also frequent. These small plots are very frequently thus half destroyed before cut. I have seen them *wholly* destroyed. In plots of 100 acres the per-centage of loss from this cause would be insignificant.

Sugar-cane can be grown anywhere in Bengal proper without irrigation. The crop is, of course, greatly helped (when rain is short) by manure and deeper cultivation. Of all crops that Europeans (even amateurs) attempt in Bengal, I have noticed none in which they succeed so well as with sugar-cane. Their deeper cultivation, manuring, and more careful weeding, tell upon sugar-cane. In several cases missionaries have spoken to me in surprise of the enormous profits they have obtained from a few acres of sugar-cane. In the present reports the sugar-cane crop is said in India, to average 6L. an acre; so that it will pay for "high" cultivation.

As to the advice given to Government to bring a Mauritius or West Indian planter to grow sugar-cane for them in Bengal, I think any European gardener in the Bengal service fully competent to grow sugar-cane there, probably more competent than a stranger who understands neither the language nor the people. The chief difficulty of unskilled Europeans in raising sugar-cane is the procuring good tops for setting.

As to the white ants of Mr. Goodridge, they are fearful in Central India, troublesome in Chota Nagpore, unimportant in Bengal.



I agree with Mr. Goodridge that it is not possible to introduce large culture by the aid of native cultivators or of native capitalists. If Government is to attempt its introduction, it must be by Europeans. Many opportunities have occurred for trying the experiment at small cost. The European gardeners, Mr. John Scott and others, have observed to me that if it is wished that their efforts should be profitable Government should set them to work to grow sugar-cane, or Khejoor (*Phoenix sylvestris*).

Yours, &c.  
(Signed) C. B. CLARKE.

W. T. Thiselton Dyer, Esq., F.R.S.

#### INDIA OFFICE to ROYAL GARDENS, KEW.

India Office, Whitehall, S.W.,  
February 19, 1890.

SIR,

I AM desired by the Secretary of State for India in Council, to forward to you the accompanying copy of correspondence received from the Government of India, on suggestions recently made by Messrs. Travers and Son, for the improvement of the production of cane sugar in India.

Viscount Cross is of opinion that some of these letters might with advantage be made public through the medium of the *Kew Bulletin*.

I am, &c.  
(Signed) A. GODLEY.

The Director, Royal Gardens, Kew.

No. 8 of 1889.

#### GOVERNMENT OF INDIA.

#### REVENUE AND AGRICULTURAL DEPARTMENT.

#### AGRICULTURE.

MY LORD,

Calcutta, December 24, 1889.

IN a Despatch, No. 38, dated 28th May 1889, your Lordship referred for our careful consideration a letter, dated 8th May 1889, from Messrs. Travers and Sons, advocating the improvement of sugar manufacture in India, and suggesting the possibility of a few model factories being established in suitable districts by the Government of India.

2. Messrs. Travers' letter was circulated to all local governments for opinion, and we now enclose the replies which have been received.

3. The improvement of sugar production and manufacture in this country has been the subject of attention both of the authorities and of capitalists since the beginning of the century, and various attempts have been made to establish factories, none of which appear to have been attended with any permanent success unless supplemented by the



sale of rum and liquors. Sugar refining alone has not proved sufficiently profitable to maintain a factory. If this had been the case, there appears to be no reason why the industry should not have been largely taken up by private capitalists.

4. Some of the main difficulties against which the industry has to contend are believed to be these :—

- (a.) The cultivation of sugar-cane is limited by the supply not only of water for irrigation but also of manure.
- (b.) As cultivation in India is confined to small farms or holdings, each cultivator who is able to grow the crop at all can only find manure enough for a small area, generally less than half an acre, of sugar-cane. The plots of sugar-cane are therefore greatly scattered even in a canal-irrigated tract.
- (c.) A central factory has accordingly to bring in its supplies of cane in small quantities over varying distances, in many cases the distance being great.
- (d.) The carriage of canes over a long distance, even in a climate like that of the Mauritius, is detrimental to the juice for purpose of sugar making. It is much more so in India, where the canes ripen at the season when the atmosphere is driest, and suffer, therefore, the maximum of injury.
- (e.) The Mauritius system of growing large canes at intervals is not adapted to the greater part of India, where, in order to prevent the ingress of dry air into the fields, small canes have to be grown in close contact.
- (f.) The amount of cane which can be grown, limited as it is by the supply of water and manure, barely suffices for the wants of the Indian population. It seems to be at present as profitable to produce coarse sugar for their use, as highly refined sugar for exports. There is, therefore, no sufficient inducement to capital to embark on the more difficult and expensive system.

5. A further obstacle to sugar refining in India exists in the high differential rate which the conditions of our excise system require to be placed upon spirits made on the European method as compared with that levied on spirits manufactured by the indigenous process. The sugar refiner in India is thus placed at a disadvantage in respect to the utilization of his molasses in the form of spirits.

6. In view of the circumstances above noted we are unable to advocate any attempt being made at the cost of the State to establish model factories. We are inclined to attach much confidence to the views and conclusions formed by Messrs. Thompson and Mylne, who have paid, for many years, practical attention to the subject of sugar cultivation and manufacture by ryots, and were the first to introduce the portable sugar-mills which have now spread over India. They advocate the gradual improvement of the ryots' method of manufacture, rather than the introduction of more expensive and centralising systems. The provincial departments of agriculture have, of recent years, directed attention to this question and may usefully be desired to continue to do so.

7. We are also willing to advocate the establishment of agricultural experiments in those comparatively limited tracts of the country (such as Eastern Bengal, where there is a moist climate and a more or less abundant supply of manure) in which the Mauritius methods of cultivation have *prima facie* some prospect of success, and we are



prepared to advise our local governments and administrations to give every reasonable support to sugar factories and refineries which may be established by private enterprise.

We have, &c.

LANSDOWNE.

G. CHESNEY.

A. R. SCOBLE.

C. A. ELLIOTT.

P. P. HUTCHINS.

D. M. BARBOUR.

The Right Hon. Viscount Cross, G.C.B.,  
Her Majesty's Secretary of State for India.

From Messrs. J. TRAVERS AND SONS, LIMITED, to the UNDER-  
SECRETARY OF STATE FOR INDIA.

London, May 8, 1889.

WE are obliged by your letter dated 4th instant, with reference to sugar in India, and we have carefully looked through the accompanying reports and statistics.

The average production of India is given as a ton of sugar per acre, and the produce (with the exception of the three modern mills in Madras) is of a most wretched character.

In the West Indies (which are also backward) sugar growers obtain two tons of sugar per acre, or double the Indian average, and, with modern machinery, properly crystallized sugar can be made direct from the cane juice at a cost on the spot (that is, without carriage) of 8s. to 10s. per cwt.

It is no doubt the competition of such direct cane sugar from Mauritius which is leading to the closing of refineries in Bengal, if, as we imagine, those refineries work, not from the sugar-cane, but from coarse native sugar.

In all the statistics sent us, Mauritius and similiar sugars are described as *refined*, but this is altogether misleading. There are no *refineries* in Mauritius where sugar is remelted, and the produce of the island is *simply raw sugar properly made by modern processes*.

It is such sugar that India ought to make, and the Empire, with sufficiently improved cultivation and machinery, might readily supply the world with sugar. Refining is a secondary process, likely to altogether die out, by slow degrees, as cane and beet manufacture becomes more perfect. The disappearance of refining in Bengal, though hard upon individuals, is really a sign that there is progress elsewhere, and progress which no country is better adapted than Bengal to share in.

That modern sugar can be well made in India is shown by Messrs. Minchin at Aska, Madras, and it is simply absurd that India should have first to export the labour to Mauritius, and then to re-import sugar from that distant island, which could be as well made, and certainly more cheaply, at home. India is generally regarded as the home of the sugar-cane, and with its teeming population, its climate, and (in some districts) its plentiful water and coal supply, it should be a large exporter of fine sugar instead of an importer.

The manufacture of modern (or, as it is called, vacuum pan) sugar, to be profitable, must be on a large scale, because it involves costly machinery and chemical and mechanical supervision impossible for ryots, who probably do not extract one-third of the sugar that might be extracted from their crops, and make that third in a shape that looks



more like manure than sugar, and which appears to fetch in many parts of India as little as 6s. per cwt. on the spot, whereas Mauritius sugar in India must net double that to pay the grower.

Vacuum pan sugar making is, probably, only possible on a large scale in India through the central factory system, where the raw canes are bought by the mill from the growers. A system similar to this already prevails in indigo and silk mills in Bengal.

We do not know whether the Government of India would be able to start a few model factories in suitable districts, or whether they must confine their attempts to develop sugar manufacture to the collection of information and figures like those in the returns forwarded to us. In any case, the efforts of the Government in this direction for some years past cannot fail to be of great value.

From the DIRECTOR, DEPARTMENT OF LAND RECORDS AND AGRICULTURE, N.-W. PROVINCES AND OUDH, to the SECRETARY TO THE GOVERNMENT OF THE N.-W. PROVINCES AND OUDH.

No. 95 T.S., August 30, 1889.

I HAVE the honour to submit the opinion called for by your No. 1192—L-325 A., dated 12th August 1889, on the memorandum of Messrs. Travers and Sons, of London, regarding the sugar production of India. In compliance with your instructions I have forwarded a copy of this letter direct to the Government of India.

2. The suggestions made by Messrs. Travers and Sons is that the Government of India might start a few model factories for the preparation of sugar by modern processes in suitable districts. This appears to be the only point of practical importance in the memorandum. In my opinion the Government would be ill-advised were it to act on the suggestion. I base my opinion on the general ground that private enterprise in India is now sufficiently alert and well organised to undertake the business of sugar refining on a large scale and with ample capital if there were a reasonable prospect of success. That sugar refining companies working on scientific principles, such as the Rosa Company and the Aska Factory, show no signs of multiplying in India is, to my mind, a clear proof that, under existing commercial conditions, the prospects of successful trade are small. Nor is the explanation why prospects are not encouraging far to seek. European sugar refineries in India have two markets, and two only, open to them. They can manufacture for export to Europe, in which case they have to contend with the bounty-aided sugars of the Continent, and are no more able than the Mauritius factors to make a reasonable profit on their capital in such a market. Or they can manufacture for local consumption in India, endeavouring to supplant sugars refined by native or crude European processes, and sugars imported from the Mauritius. Here they are met with the great difficulty that the mass of the native population regards with dogged suspicion all machine-made sugar, holding it to be impure and contaminated with bones and blood. The market is thus a very small one, and the prices ruling in it are by no means improved by the quantities of similar sugar thrown in despair upon it by Mauritius planters. Assuming that the cost of producing a given amount of crystallized sugar by modern processes is about the same in India and in the Mauritius (and from such information as I have at hand, I do not think a sugar refinery in India could manufacture cheaper than the Mauritius planter), what are the probabilities of commercial success? They are bounded, it seems to me, by the actual



success attained by the Mauritius planters, and as we are constantly told that sugar in Mauritius does not pay, scientific sugar refining in India is not a hopeful industry. The Rosa Factory in these provinces depends more on its rum than on its sugar, and I believe this is the case with the few other similar concerns existing in other provinces.

3. The memorandum refers in contemptuous terms to the quality of the common sugars consumed by the Indian public. But they have an almost unlimited and active market, which is at present closed to machine-made sugar; and even if superstitious prejudices could be overcome, there would still remain the question of national taste. The compost known as *gur* has a peculiar flavour which is absent from machine-made sugars, and the tastes of a most conservative people will require to be changed before the local markets of India really open to the European sugar manufacturer.

4. I admit all that the memorandum says as to the smallness of the yield of sugar per acre in India, as to the inferiority of the processes employed to extract the juice and make it into sugar, and as to the low quality of the so-called "refined sugars" of India. But it is conceivable that these rude processes and this small outturn may yield a profit, while scientific processes and high cultivation result in a loss. Not only does the Mauritius system require a large initial capital expenditure and a large annual outlay, but it also requires a highly-paid supervising and controlling agency. I do not defend the imperfections of the Indian system, but I think it is economically explicable.

5. There would be some difficulty in introducing the Mauritius system bodily into India, since a prominent feature of that system is that planting and manufacturing are concentrated in the same hands. But, as the memorandum points out, a sugar refinery might easily work in an Indian sugar growing district on the lines familiar to indigo planters. It would buy cane at the proper season from cultivators of the neighbourhood, and would restrict its interest in the actual production of the crop advances to the growers. A large sugar refinery, I may point out, would have to face two problems which are not easy to solve. The first is the question of carriage. Cane soon dries when cut and cannot be carried long distances. A sugar refinery has thus to depend for its raw material on a small area devoted almost exclusively to the production of sugar, and this is opposed to the habits and traditions of the Indian agriculturist. The second difficulty is that the machinery of the factory would stand idle for a great part of the year and occupation would not be forthcoming for the hands, unless a subsidiary business, such as the manufacture of rum, is added to that of sugar refining. The market for rum in India is not large, and is probably sufficiently supplied by existing concerns.

From J. P. GOODRIDGE, Esq., OFFICIATING DIRECTOR, DEPARTMENT OF LAND RECORDS AND AGRICULTURE, CENTRAL PROVINCES, to the SECRETARY TO THE GOVERNMENT OF INDIA.

No. 1783—89 A., Nagpur, 29, August 1889.

IN compliance with the instructions contained in your Circular No. 54—21—15A., dated 30th July 1889, I have the honour to submit the following observations on the views and suggestions of Messrs. Travers and Sons, of London, in regard to the sugar production of India.

I may mention that I am interested in sugar plantations in the Island of Barbados, and have frequently visited that island, the last occasion being in 1879.



2. The production of sugar in the Mauritius, with which Messrs. Travers compare India for the purpose of showing how backward the industry is in this country, is, as I gather from the information that I have been able to obtain, carried on under circumstances very similar to those which exist in the West Indies. In both countries there are found—

- (1.) Sugar plantations of considerable size managed by Europeans and persons of European descent, and cultivated by paid labour by negroes in Barbados, negroes and coolies in Trinidad, and by Indian coolies in Mauritius.
- (2.) The employment of a considerable capital in this industry and the application of steam and mechanical and latterly of chemical science in the manufacture of sugar.
- (3.) An abundant rainfall of 40\* inches per annum well spread throughout the year (though there is a well-defined rainy season) affording adequate moisture during the months in which the cane crop is on the ground. The occurrence of frequent showers falling on a naturally well-drained soil which rests on porous coral or coralline rock that prevents stagnation and water-logging.

3. To those acquainted with the present condition of Indian agriculture it is only necessary to state the above circumstances to explain the great difference in the cultivation of the cane and the manufacture of sugar in the West Indies and the Mauritius and in this country. Here the great bulk of the sugar production is by *la petite culture*. Instead of an energetic race who have devoted themselves for generations to the sole object of producing sugar we have an ignorant peasantry wedded to their own primitive methods of cultivation, and cultivating, perhaps, a few acres of cane in addition to their wheat, rice, and cotton crops. I think it would be difficult in these provinces to find many cultivators who have more than five acres of land under sugar-cane. In the Sambalpur district, where most of the sugar of these provinces is grown, the whole body of cultivators in a village club together and sow about eight or ten acres, the area being divided among them into small strips. The Indian ryot has neither the inclination nor the means of improving his style of cultivation. Instead of a steady and well distributed rainfall, we have nearly all of our rain during four months of the year, with an occasional shower at Christmas and a dry season during the rest of the year. Hence at one season the cane is water-logged if not well drained, while at another it suffers from drought. To grow a crop of cane, irrigation from canals and rivers, or from tanks and wells is necessary, whereas in Barbados, and, I believe, in the Mauritius also, irrigation is not required, and is never practised.

4. It would be difficult to say whether the differences between the Indian and West Indian methods are most marked in the cultivation of the cane or in the manufacture of sugar. In the West Indies the ground is well prepared with the hoe and manured with farmyard manure, which is placed at the bottom of the cane holes where it is wanted by the young cane. The whole field is afterwards carefully “trashed,” by which means the ground is covered with a bed of cane straw a foot thick which retains the moisture round the roots of the young plants and prevents the surrounding grounds from being baked by the sun.

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\* The average rainfall of Barbados for the 25 years from 1847–1871 was 57·74. In the Mauritius it is now about 40 inches per annum, though formerly, before the destruction of the forests, it was much more. [This is doubtful.]



In this country the manure applied, whether it be in the form of cow-dung, the droppings of sheep, or the alluvial deposits of tanks, is spread broadcast over the surface of the field, and is exposed to the atmosphere. In the West Indies and in the Mauritius large quantities of guano *nitrophosphates* and other mineral and artificial manures are used. This is applied to the plants after they have made considerable progress in their growth. In this country the cane rarely gets a fresh supply of manure after it is planted. It is grown from the mature cane cut up into short pieces, and laid horizontally on the ground. This is the most wasteful method and entails a large expenditure of cane for planting, perhaps as much as 10 per cent. of the whole produce.

5. The young plant instead of firmly establishing itself by striking its roots downwards in search of food spreads them over the manured surface. It consequently becomes weak and straggling, and at a later period falls to the ground, and has then to be propped up by interlacing one cane with another, or by means of small bamboos. From the moment it is put down till the young plant has provided itself with roots it is exposed to the ravages of white ants, which find a convenient *nidus* in the manurial substances used, and attack the plants before they can establish themselves. In some villages in which these pests abound it is found impracticable to attempt sugar-cane cultivation, and it is not uncommon to find considerable vacant patches in a cane field, the work of this destructive termite. Some years ago I introduced in the Sambalpur district the West Indian method of planting the cane tops vertically in hollows, and between  $3\frac{1}{2}$  feet square banks, instead of sowing pieces of the mature cane horizontally on the level ground. This resulted in more vigorous canes and in large clusters, but the system had one drawback compared with the native method. If the white ants destroyed the cane tops before they could be converted into healthy plants, there was nothing left but a bare field or one with numerous empty patches in it. On the other hand, even if two-thirds of the seed canes laid closely on the surface of the ground were destroyed, the other one-third was left for a crop. These destructive insects not only eat up the cane seed, but consume a good deal of the manure. To check their ravages the Indian peasant finds it necessary that his manure should be placed where it is wanted and weathered during the rains before it is used. The insect does not then attack it with the same vigour as it does fresh manure. This exposure to the atmosphere, of course, deprives the manure of much of its fertilising power, but it is better that the cane should be stunted or dry than that the ryot should have half of his field lying in empty spaces. It is well known that the amount of saccharine in the cane is dependent entirely on the stage of its growth. Hence the West Indian planter closely watches his cane fields and cuts them at the right moment. The delay of a week would most seriously affect the outturn of sugar. The postponement of a month might be ruinous in these days of keen competition with bounty fed beet sugar, and when the margin of profit is so small.

The Indian peasant, on the other hand, considers the time for reaping his canes an unimportant matter, and they are allowed to remain standing and to flower until he finds a convenient moment for reaping them.

6. The Indian method of manufacture of sugar is as wasteful and primitive as the system of growing the cane. In the West Indies the cane is crushed in powerful mills with cylindrical rollers  $4\frac{1}{2}$  feet long by  $3\frac{1}{2}$  feet diameter, driven by steam or wind and with every mechanical contrivance to extract a maximum amount of juice from the cane. Even the powerful crushing apparatus which has hitherto been used



has, in the present struggle with beet, been superseded in some estates by chemical methods by which the whole of the saccharine substance is extracted from the cane. But I will compare the Indian method with what may be called the old West Indian system, not with the scientific process of later years. The cane juice or "liquor" as it is called is subjected as soon as it is extracted to a process of defecation and clarifying in large vats, and is at once passed through several large "tayches" till the liquor is reduced to the condition of a thick syrup. It is boiled at a low temperature in vacuum pans, by which means a more highly crystalline mass is obtained. It is then placed in a centrifugal, a rapidly turning machine which separates the crystal from its parent syrup. The whole is cooled in large shallow vats and afterwards put into hogsheds perforated so as to permit the molasses to percolate through the sugar. When the molasses has been drained off in the stanchions, the sugar is said to be "cured" and is in the form of the fine large grained crystalline, whitish brown sugar, or grocery sugar of commerce.

7. This process is very different from that adopted in this country; instead of the large boiling-house with its long line of enormous copper "tayches," its vacuum pans, and ingenious and economical heating apparatus by means of which the megass or woody fibre of the cane alone suffices to make the sugar, its centrifugals and its curing room, we have rough and improvised huts formed of branches and twigs placed at the corner of a cane-field. Here is put up a small crushing apparatus generally of wood, consisting of two or three rollers of about  $1\frac{1}{2}$  feet high and 10 inches in diameter and worked by a lever, moved by a bullock or a pair of bullocks. The cane is cut up into small strips by the owner, his family and friends, who consume a good deal of cane juice in the process of "gur" boiling. Only a small per-centage of the juice is extracted from the cane by these small and inferior mills so deficient in crushing power. The pressed liquor is placed in large earthen vats and exposed to a quick fire. It is boiled just as it comes from the mill, and no effort is made to cleanse or clarify it. The whole is then reduced by heat to the proper consistency, and is thrown into a hole in the earth specially prepared for it and cooled long before the process of crystallization has set in. The finished article is more like a mixture of sand and dough sweetened with molasses than the sugar of commerce.

8. In later years the wooden mill rollers have been succeeded in some places by iron ones, the best known being the Beheea mill of Messrs. Thomson, Mylne, & Co. This, as far as the rollers are concerned, is a miniature of the vertical West Indian sugar mill. It is of course only intended for sugar making on a small scale. In some districts of these provinces these mills are used, but in many others the people do not buy them and declare that, on the whole, the old wooden mills are better suited to their wants. The reason probably is that the village carpenter and blacksmith have to be supported in any case whether they make the old-fashioned wooden mill or not, and the ryot, who never has much spare cash for improvements of this kind, considers it cheaper to use this than to pay R. 150 for an article which he will need only for a few weeks in the year. I have never known an instance of a village community clubbing together to purchase one or more of such mills. Attempts have been made to introduce flat iron vats for sugar-boiling, but they are expensive and not much appreciated, and most of the "gur" of these provinces is made in large earthen pots. Iron rollers and iron vats will no doubt in time supersede wooden rollers and earthen pots, but in these provinces the industry is still



carried on by primitive methods which were perhaps in vogue 500 years ago. In most places the megass or woody fibre of the cane is thrown away as useless. Efforts are now being made to show the value of this substance for boiling sugar, but it is only in those districts in which a difficulty is felt in obtaining fuel that the people show any inclination to utilise their megass.

9. Such being the facts, it seems a matter for surprise that the out-turn per acre of sugar-cane cultivated by the Indian method should, as shown by the statistics, be less than in the Mauritius by one ton only. As a matter of fact, however, the produce per acre in Barbados is from  $2\frac{1}{2}$  to 3 tons, while in this country the produce of the same area, while nominally one ton, consists of such an inferior substance that the actual sugar yielded is considerably less than that quantity.

10. I now proceed to consider the question whether anything can be done to improve the method of production in this country. It is obvious that but little improvement can be effected under present conditions. The first thing necessary is that sugar should be grown on a larger scale, and its manufacture supervised by properly trained and experienced persons working with an adequate machinery. For making sugar Messrs. Travers suggest the introduction of the central sugar factory, where the canes of several cultivators could be converted into sugar. It is doubtful, however, whether a central factory would answer in this country. Even if the Indian cultivator could be induced to bring his canes there to be made into sugar, which is not likely, there would be other insuperable difficulties. Here the sugar-cane fields are spread over a large area, and are in patches, instead of being concentrated as in the West Indies, where cane field touches cane field. In some of the West India islands, and especially, I believe, in the French colonies, where labour is scarce and proper supervision costly, "usines" or sugar factories have been established. Instead of each plantation having its own boiling-house one "usine" serves for several. But even in the West Indies this system is worked with some difficulty, and necessitates the construction of roads leading from the cane fields to the factory. In India their establishment would be quite impracticable considering the present scattered state of the cultivation. I doubt whether there are many villages in these provinces which contain as much as 50 acres of cane. To enable a central factory to work successfully an area of at least 500 acres of cane would be needed. Speaking from my recollection of Barbados, where there are many small estates, a boiling-house for an estate of less than 100 acres is exceedingly rare. Persons who grow cane in a smaller way use their neighbours' boiling-houses, giving them a share of the manufactured article.

11. There is much scope for the establishment of large sugar plantations in this country in places where the soil is good, labour cheap, and an ample and certain supply of water available. Land in northern India in the vicinity of the canals would, I should say, be admirably adapted for this purpose. There the soil is good with a perennial supply of water for irrigation and a redundant population.

The soil and climate of certain portions of the Central Provinces, where there is, or could be, considerable irrigation from tanks as in the Sambalpur and Bhandara districts and in some of the Feudatory States of Chattisgarh, would also be suitable. The former would probably be more suitable than the latter, for while the canes might occasionally suffer from frost in Northern India, in the Central Provinces the supply of tank water might fail in years of insufficient rainfall.



12. For the formation of a plantation after the model of those in the Mauritius and in the West Indies the action of the Government will, at any rate in the first instance, be necessary.

The small cultivators of India have neither the means nor the inclination for undertaking such a task. It would never occur to a large landowner in this country to make money by growing sugar on a large scale by new and improved methods and by the expenditure of a considerable capital. By the trading classes the whole thing would be regarded as entirely beyond their sphere of action. The only persons who would perhaps have the requisite enterprise and means to undertake such an industry on a large scale are European planters who can command the necessary land and capital, but they have already profitable crops like indigo, which do not involve the same expenditure and which can be carried on without extensive irrigation. It would be impossible for a West Indian planter, supposing he could command the necessary capital and was prepared to make the venture, to provide himself with the requisite land. There are, it is true, extensive waste lands in this country, but they are quite unsuited for such an undertaking. \* \* \* \*

13. It will be necessary, therefore, for Government to take the initiative in this matter, and by means of the Land Acquisition Act or other appropriate procedure to acquire land sufficient for the establishment of a sugar plantation of 500 or 600 acres. This might be offered rent-free or on easy terms to a practical planter under certain conditions for a term of years, and he might also be given a subvention to aid him in providing the necessary machinery for the manufacture of sugar.

There must be many enterprising planters in the Mauritius, accustomed to Indian coolies who would be glad to accept an offer of this kind. By making success dependent on the efforts of the person chiefly interested in the project, there would be a guarantee that everything would be done to make the scheme a success. But in the event of no practical sugar planter being willing to undertake the responsibility of a sugar plantation on the above terms, it would be well for Government to establish a few model plantations of its own in different parts of India. I understand that some years ago the services of a sugar planter were obtained from the West Indies for the *daira* lands of the Khedive, and that a vast improvement followed the introduction in that country of the West Indian method of growing and manufacturing sugar. With a plentiful supply of water, such as would be afforded by our canals and large tanks, a good soil and cheap labour, no great difficulties would be encountered in the establishment of a sugar plantation. If the scheme were once shown to be successful, it is probable that many persons who can command large areas suitable for sugar-cane cultivation and the necessary capital would adopt it. The greatest difficulty to be encountered would be the securing of an adequate supply of manure. Much of the *cowdung* of this country is used for fuel, and, consequently, good farm-yard manure in large quantities is not readily obtainable. But if sugar cultivation by the West Indian method were shown to be profitable, mineral and artificial manures would be available in India as they are in Barbados and in the Mauritius.

14. The value of such a plantation would not be confined to improving the production of sugar. It has often occurred to me in establishing model farms and placing at their head men trained in England and having a practical knowledge of the agricultural methods only of countries with a temperate climate, that we have somewhat overlooked



the fact that the conditions of agriculture in the greater portion of India resemble those of the West Indies or the Southern States of America much more closely than they do those of Europe, and that it is in these former countries that those Indian crops which are most susceptible of improvement, such as rice, cotton, tobacco, Indian corn, sugar, tropical roots, vegetables, and fodder crops, are cultivated with the greatest success.

15. The West Indies, like Mauritius, import the greater portion of their food, but a good deal of Indian corn and vegetables are also grown in these islands. A plantation is generally divided into two portions, one is under cane, and the other is under preparation for cane, and is, in the interval, used for growing short crops, sweet potatoes, yams, Indian and guinea corn (juari)—the two latter with guinea grass supplying the necessary fodder for the farm cattle. All of the above crops are capable of great improvement and extension in India. While in this country a few yams are to be found in *pân baris*, the plant is reared in the West Indies in large open fields. The difference between the sweet potato of India and that of the West Indies is striking. The former is generally an elongated tuber 5 inches long and 3 inches in diameter and is grown on a flat surface. In the West Indies it is ordinarily an ellipsoid, with axes of 10 and 7 inches, and grown in rows on banks, and not on level ground. There are other striking differences in the systems pursued in rearing other crops in the West and in the East Indies. The establishment of a plantation on the West Indian model in this country could not, I think, fail to improve the cultivation of all tropical products, and to instruct the people in methods of which they have no idea at present. Some of the return coolies from the West Indies and the Mauritius might also be induced to take service in such plantations, and by instructing their countrymen would be of use to the manager in starting the work.

16. I might usefully recapitulate the above remarks as follows :—The improvement of sugar production in India is not possible, under existing conditions of scattered cultivation by numerous small cultivators, and in view of the fact that it is nowhere a staple, but merely a subsidiary crop, I have further endeavoured to show—

- (1.) That cultivation on a large scale is essential, if the requisite supervision in growing the cane, and the necessary machinery for manufacturing sugar, are to be provided.
- (2.) That a change cannot be brought about unless an adequate area of irrigable land in a healthy and well-populated country with cheap labour is first secured.
- (3.) That private effort and enterprise are probably unequal to the task of securing the conditions necessary for successfully starting the work.
- (4.) That it will therefore be expedient, in the first instance at all events, for Government to take the initiative and to establish a model sugar plantation.
- (5.) That the best method of working such a plantation would be to interest the manager in the success of the scheme by leaving the profits to him, Government assisting by finding the land and giving it rent-free or at a low rent on certain conditions, and, if necessary, by a subvention to aid in the construction of the necessary buildings and in supplying the machinery needed.
- (6.) That in the event of no properly qualified person being willing to undertake the establishment of a sugar plantation on the above terms, Government should itself arrange for the working of the scheme by a paid agency.



- (7.) That it would be absolutely essential for the success of any scheme of this kind that the manager should be a successful and practical sugar-planter preferably from the West Indies or the Mauritius and accustomed to deal with the Indian cooly.
- (8.) That the establishment of such a model plantation would not only prove the superiority of the West Indian over the Indian system of sugar production, but would bring to the notice of Indian agriculturists the advantages of other modes of cultivating many tropical crops which, though of great value, have hitherto been much neglected in this country.

[INDIA OFFICE to ROYAL GARDENS, KEW.]

India Office, Whitehall, S.W.,  
27th February 1890.

SIR,      IN continuation of my letter of the 19th instant, I am directed by the Secretary of State for India in Council to forward the accompanying copy of a further letter from Messrs. Travers and Son on the subject of sugar manufacture in India.

I am, &c.  
(Signed)      C. E. BERNARD,  
Secretary,  
Revenue and Statistics Department.

The Director,  
Royal Gardens, Kew.

[ENCLOSURE.]

MESSRS. TRAVERS AND SON to the INDIA OFFICE.

119, Cannon Street, London, E.C.,  
21st February 1890.

SIR,

WE have to acknowledge, with thanks, your letter of the 19th instant, enclosing some correspondence with the Indian Government on the subject of our letter of the 8th May 1889, with reference to sugar manufacture in India.

We observe that while all the officials who have reported fully confirm our information as to the great and, indeed, excessive waste in Indian sugar manufacture, yet that they are able in some degree to explain the causes of the existing state of things, while the opinion is general that it would not be wise for the Government to establish experimental central sugar factories.

It would be presumptuous on our part to offer any comments on a question so fully taken up by the local authorities on the initiative of the Secretary of State.

It only remains for us, in concluding the correspondence, to acknowledge the very great courtesy with which our necessarily imperfectly informed remarks have been received, and the promptitude with which action has been taken, owing to the recognition by the India Office and the local authorities of the great importance of sugar manufacture to India, and the possibility of a great development in it.

We are, &c.  
(Signed)      J. TRAVERS AND SON.

The Under Secretary of State for India,  
India Office, Whitehall.

P.S.—We may mention that “German granulated,” a small dry white crystal sugar made direct from the beetroot, is now being shipped from

Hamburg to India, so that the ryots will not have Mauritius only to compete with at home. We believe that this sugar costs about 16s. per cwt. laid down in Bombay, and that the bounty on the export does not exceed 6d. to 9d. per cwt.

## CXLI.—MITES ON SUGAR-CANE.

Specimens of Mites affecting sugar canes at Barbados were forwarded to Kew by Mr. John R. Bovell, Superintendent of the Dodd's Botanical Station. The Mites were found to affect specimen canes under experimental trial at the Station, as well as on two neighbouring estates. It was estimated by Mr. Bovell that canes affected with Mites would yield only about one ton of sugar per acre, as against three tons per acre from unaffected canes growing on the same estates under identical conditions in regard to soil, manure, and tillage. The Mites are very minute, and usually live under the leaf-sheaths of the canes. They are doubtless present in many other sugar-producing countries, but have escaped notice. The specimens received from Barbados have been very exhaustively examined by Mr. A. D. Michael, F.L.S., who has kindly prepared the following valuable report on the subject:—

### REPORT ON DISEASED SUGAR-CANE from BARBADOS, forwarded by Mr. JOHN R. BOVELL.

Mr. Bovell's excellently packed box reached me with the various creatures alive, and apparently uninjured. I found upon the canes five sorts of *Acari*, viz. :—

1. *Histiostoma rostro-serratus*.—This is a small opaque, white mite often found in great numbers. It may be disregarded, as it is a follower, not a causer of decay. It is only useful to mention it, in order that it may not be mistaken for the real enemy. The best drawing of it I know is in a paper by Mègnin, "Mémoire anatomique et zoologique sur un Nouvel Acarien de la famille des Sarcopsides, &c.," in Robin's *Journal de l'Anatomie et de la Physiologie*, 1876, p. 369.

2. Numerous forms of immature *Gamasidæ*.—These are friends, being predatory creatures, doubtless present to feed upon the real destroyers. The *Gamasidæ* vary greatly, but drawings of type species may be found in any book on *Acari*.

3. The *Damaeus*, or *Notaspis*, originally sent by Mr. Bovell.—This I found in all stages, and, from the position in which it was found and the parts it was feeding on, I am decidedly of opinion, as Mr. Bovell supposes, they were doing damage. But in the canes sent the numbers of these *Acari* are small—certainly not sufficient to account for the extensive damage spoken of by Mr. Bovell; and, looking at the analogy of the allied species, I am still of opinion that this species is probably not the principal cause of the evil.

4. Two species of *Tarsonymus*.—*Acari* of this genus are almost invariably great destroyers of vegetable life. They are extremely minute and almost transparent, and, therefore, are likely to escape the notice of anyone except a practised microscopist, or a person specially looking for them and provided with sufficient microscopical instruments. These *Tarsonymi* were absolutely swarming upon every sample of the cane sent; they were in all stages. They were chiefly found in the axils of



the leaves. The larger species is certainly identical with the acarus which Dr. Bancroft found doing such serious damage to the growing sugar-cane in Queensland, and which is unnamed, but ought fairly to be called *Tarsonymus Bancrofti*. Dr. Bancroft evidently had not sufficient knowledge of the *Acarina* to know what family his mite belonged to, but he appended drawings to his report, which are good, and render the nature of the creature quite unmistakeable (2nd Annual Report of the Board appointed to inquire into the causes of Diseases affecting Live Stock and Plants. Queensland, 1877). I believe this *Tarsonymus* to be the principal destroyer. There are present in the canes (in addition to the *Acar*i) a large number of *Anguillulæ*. It should not be forgotten that although these are probably as a rule followers of decay yet they are often causers of it.

All the specimens of cane sent were in a tolerably advanced state of the disease, and consequently of decay. It would be well worth Mr. Bovell's while to examine specimens in which the disease was only just commencing, and even the neighbouring canes which still appeared healthy, so as to ascertain, if possible, which creature commences the evil. If he has not the means of doing this I should be happy to assist him.

With regard to the important questions of how to cure the evil the same means would probably be applicable to the *Damæus* and the *Tarsonymus*. The latter would be more easy to destroy than the former, as the hard cuticle of the adult *Damæus* is practically impervious to chemicals. Boiling water and dessication are at once destructive of life in both species. These means, however, of course cannot be employed on the canes, but might sometimes be useful with infected material to be used as dressings, &c. The means employed by Dr. Bancroft were steeping the canes before planting in carbolic acid and water for 24 hours. The strength he was trying was 1 lb. of acid to 100 gallons of water; he also tried prolonged immersion in lime dip (milk of lime). These means are probably as good as any that can be adopted, but a mixture of powdered sulphur in soap and water is also a very good destroyer of this class of life. Whatever chemicals be employed I would suggest that it would be desirable, where possible, instead of applying the remedy once only, to do so two or three times at intervals of, say, a fortnight, because the eggs of *Acar*i have a shell which, as a rule, is quite impenetrable to chemicals, and therefore, although the larvæ and adults may be destroyed, the eggs survive; and to really clear the plant it is necessary to catch the larvæ when they emerge from these eggs. Of course, infected *débris* should be burned.

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As Mr. Michael's very complete investigation also incidentally clears up what was doubtful in the long mysterious "Red Rust" of the Queensland canes, it will be convenient to reprint here, from the Kew reports for 1877 and 1878, the account there given of its investigation.

EXTRACT from the "Report on the Progress and Condition of the Royal Gardens, Kew, during the year 1877," pp. 37-38.

#### *Sugar-cane Disease.*

The disease which I mentioned in my last report as having inflicted great injury on the sugar-cane in Queensland (where it is known as "rust") has engaged a good deal of our attention. The examination of the numerous documents, both printed and written, which have come



into my hands, as well as of the specimens of diseased cane, unfortunately far from satisfactory, which have been transmitted to us from the Colony, have led to the following conclusions, which have already been communicated to the Queensland Government :—

1. It appears not improbable that the disease is identical with one which has been noticed in the Malayan Archipelago, and in Mauritius [Journal Royal Horticultural Society, New Series, vol. ii., pp. cxxxi–cxxxii], in the Society Islands according to Professor Liversedge, and in Bahia [Journal Royal Horticultural Society, New Series, vol. iii., pp. 14–17].

2. It is recognised by the appearance on the leaves of red spots known as “rust,” which increase in number till the whole leaf withers, and ultimately dies. When the leaf is stripped off, there is usually found inside the sheath and upon the stem a patch of dark brown or reddish incrustation.

Professor Liversedge of the University of Sydney has studied the disease, and attributes it to defective conditions of cultivation. He considers that the marks on the leaves, and the red incrustation on the stem, are caused by a fungus of the family *Æcidaceæ*, but that its attacks are the effect and not the cause of the disease. Professor Liversedge also noted the presence of acari, which he believed fed on the fungi.

3. Dr. Bancroft, in a paper presented to the Queensland Parliament in 1876, distinguished between the disease as affecting the leaf and the stem. He found that the red spots on the leaves eventually produced a fungus with black spores, and he attributed the spots to its attacks. The red incrustation on the stem he also believed to be fungoid, but was unable to throw any further light upon its cause; he detected mites (acari) at the injured spots.

4. In a subsequent paper, Dr. Bancroft (Sugar-cane, September 1877, pp. 476–480,) has shown, I think, almost conclusively that the red incrustation is the result of the attacks of an acarus which infests the young shoots of the diseased sugar-cane in immense numbers.

5. The specimens sent to this country had been carefully examined before Dr. Bancroft’s paper appeared here in print. The Rev. M. J. Berkeley and Mr. Broome, two well-known cryptogamists, satisfied themselves that the red incrustation was in no way due to a fungus, and were disposed to attribute it to the attacks of a coccus.

6. Specimens were then submitted to Mr. McLachlan, F.R.S., by whom they were sent to M. Signoret, the best living authority on the *Coccidæ*. He arrived at the opinion that the red incrustation was not the work of a *coccus*, a view in which Mr. McLachlan concurred. On a further examination of some of the specimens, Mr. McLachlan stated in a letter (September 14th, 1877) that he had found “myriads of what “ may be collapsed acari.”

7. This was independent of, and so far confirmatory of, the observations made by Dr. Bancroft. I think, therefore, that it is probable that the true cause of the so-called “rust” has now been detected. The sugar-cane being grown from joints, the acarus would easily be communicated from one crop to another. Dr. Bancroft finds that steeping the joints in milk of lime destroys the acarus, and probably a mixture of two to four ounces of fluid carbolic acid to a gallon of water would be still more effective.

8. The black spored fungus eventually produced by the red spots on the leaves is regarded by Mr. Berkeley as a new species, to which he has given the name of *Depazea sacchari*; he does not consider that it plays any part in the disease, but simply takes possession of the already moribund tissues.



EXTRACT from the "Report on the Progress and Condition of the Royal Gardens, Kew, during the year 1878," pp. 48-49.

*Sugar-cane Disease.*

In the Kew Report for 1877 the history of the various insect pests which had proved so injurious to the sugar-cane in Queensland was given in some detail.

During the past year a further correspondence has taken place upon the subject between this establishment and the Colonial Office, and a large series of specimens, carefully selected and sent over to this country in various preservative fluids by Mr. J. T. Staiger, F.L.S., Government Analytical Chemist, has been received for examination.

It appears now to be placed beyond question that the "rust" is due to the puncture of a minute acarid which exists upon the diseased cane in myriads. The exact scientific determination of this parasite would be, as I am informed by Mr. McLachlan, F.R.S., who has again most obligingly assisted us in this matter, a point requiring research of some difficulty. Mr. McLachlan states, however, that "the creature looks very like a *Tyroglyphus*, but the habits do not altogether accord with those of that genus."

I am glad to state that the treatment with lime suggested by Dr. Bancroft, and that with carbolic acid recommended in the Kew Report for 1877 (p. 38), promises to be quite effectual in keeping this pest under control. Mr. MacKay reports to the Legislative Council of Queensland the results of experiments upon diseased canes subjected to the following treatment directed by Dr. Bancroft, which I quote here as likely to be efficacious in other Colonies:—

"1. Clean the joints entirely from all trash as carefully as possible. 2. Immerse for 24 hours in water and carbolic acid at a temperature to bear the hand,—1 lb. of acid to 50 gallons of water. 3. Make milk of lime,—2 lbs. of lime to 1 gallon of water; immerse the plants in this for a few minutes. 4. Lift out and spread in the sun, turning them over to dry for one day before planting.

"Out of 24 different varieties of cane so treated I am glad to say that all except two have come up sound and healthy, and the two are but lightly touched with the disease, a few spots only showing on the outer ends of the leaves, while the heart of the cane is quite green and healthy. The old stools or roots from which were taken the plants so treated have all come up diseased, some of them died out, so that there can be no doubt that the mixture had its effect."